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Generative Models for Fast Simulation of Electromagnetic and Hadronic Showers in Highly Granular Calorimeters

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Simulation in High Energy Physics (HEP) places a heavy burden on the available computing resources and is expected to become a major bottleneck for the upcoming high luminosity phase of the LHC and for future Higgs factories, motivating a concerted effort to develop computationally efficient solutions. Methods based on generative machine learning methods hold promise to alleviate the computational strain produced by simulation while providing the physical accuracy required of a surrogate simulator.

In this contribution, an overview of a growing body of work focused on simulating showers in highly granular calorimeters will be reported, which is making significant steps towards realistic fast simulation tools based on deep generative models. Progress on the simulation of both electromagnetic and hadronic showers will be presented, with a focus on the high degree of physical fidelity and computational performance achieved. Additional steps taken to address the challenges faced when broadening the scope of these simulators, such as those posed by multi-parameter conditioning, will also be discussed.

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